arisen from the use of the tool as a club, but rather as an anvil, as pointed out more than once in reference to other stones observed by Mr. F. C. J. Spurrell and myself. Several flakes have been removed from the extreme butt, and a few small inconvenient asperities have been knocked off elsewhere. Greater part of the flint is covered with the original bark, and this bark is brownish ochreous, its colour proving its derivation from the ochreous gravel. The trimmed parts are lustrous, unabraded, and very slightly stained. The tool was no doubt made and used close to where it was found, and probably belongs to a "Palæolithic Floor," of which so many examples are known now that attention has once been drawn to them. The whole condition of the implement exactly agrees with the stone implements from Stoke Newington, Erith, and Northfleet. The tool appears to have been used as an instrument for thrusting, as well as in a horizontal position as an "anvil-stone." It would be idle to mention the possible uses of such a huge tool as this, but every one who has formed ideas of the mode of life of Palæolithic men will readily think of numerous uses to which such an implement could have been put.

In March, 1882, I had an opportunity of hastily walking through the railway cutting, and I not only lighted on several unabraded Palæolithic flakes, but I found a subtriangular somewhat abraded Palæolithic implement in a lump of concreted gravel, which had fallen out of the side of the cutting between Hounslow and Isleworth at six feet from the surface line. This implement, formerly 556 in my series, is now in the collection of Mr. John Evans at Nash Mills. I also found a large butt-end of an implement, broken in Palæolithic times, a little nearer Hanwell, and another implement in the cutting between Hanwell and Ealing.

Near Hanwell in this cutting fresh-water shells were abundant, and I do not think they have been recorded, with implements, before from this position. It is to be hoped the members of the Ealing Natural History Society collected and took note of them.

WORTHINGTON G. SMITH

AGRICULTURE, ITS NEEDS AND OPPORTUNITIES

PROFESSOR W. J. BEAL'S address on this subject, delivered before the American Association for the Advancement of Science, in August, is of interest to Englishmen from more than one aspect. In the first place its perusal gives us the means of knowing what is being done in the United States for the advancement of scientific agriculture. In the next place we are able to judge how far we excel or are excelled by our American relatives in matters connected with agricultural inquiry. Lastly, it is in such addresses that we may expect to find suggestions worthy of attention, and thoughts which in due course will develop into acts. Prof. Beal takes for his text—"Agriculture, its Needs and its Opportunities." So far as its needs go they are manifold, and its opportunities are certainly coextensive with its vast domain.

The first need is a very common one indeed—it is the need of brains. Agriculture needs brains to guide and counsel her. Prof. Beal is evidently a man calculated himself to supply this need so far as one man can so do. He invites the assistance of men of intellect to rescue agriculture, and he laments the fact that within a comparatively recent time but very little of the best thought even of civilised nations has been devoted to subjects intended to advance agriculture. He calls attention to the munificent aids granted by the United States Government for the encouragement of anthropology, astronomy, geological and mineralogical and other surveys, while but a small sum has been appropriated to agriculture. To illustrate the hesitancy of men to bequeath money for the promotion of agriculture he takes the following from an address given by President T. C. Abbot:—

"I met a very pleasant and intelligent gentleman, who, from his large wealth, was about to give some sixty or seventy thousand dollars for the advancement of higher education. He had been for some years, and was still, the president of a State Agricultural Society. He was a farmer. Did he then endow some Chair of Agriculture or Agricultural Chemistry, of Veterinary Science, or of Horticulture? Did he fit out an experiment station to analyse fertilisers, to study the value of cattle foods? None of them. This farmer gave his thousands to endow another workshop of astronomy."

The above sentences are couched in the language of indignation. They illustrate our own experience on this side of the water, for the public ever seem to take more interest in abstract science and fine art than in technical instruction. The interest in agricultural science has been always languid, albeit it has had its stalwart and enthusiastic supporters. But the public have hitherto failed to tangibly grasp the importance of the subject. It is allowed in a sort of languid and perfunctory manner, but without enthusiasm. We have recently passed through a fervid effort towards the attainment of better musical instruction by means of a College of Music. But when are Royal personages going to lead a movement in the direction of securing better instruction in agriculture? And is not agriculture as noble a subject whereon Royalty might bequeath its patronage and lavish its wealth as music?

We find then a certain unaccountable indifference to agricultural science on both sides of the Atlantic, and yet we ought not to forget that, while much more ought to be done, much has been done both in America and Europe.

The field as a field of research has not been so fruitful as at one time it was expected to prove. The old and time-honoured practices of the farmer have too often justified themselves when confronted by scientific objectors. The suggestions of the scientific man have too often been found impracticable and over-expensive by the practical farmer.

It is indeed very difficult to improve upon processes which have stood so many trials. A certain reckless assumption that old practices *must* give way to new has been the ruin of many good men. Agriculture is undoubtedly capable of improvement, but the improvement is generally most evident when established upon the old lines of good practice, and when heroic measures are avoided.

Limited production is the chief difficulty in the way of scientific agriculture. We cannot multiply our production by steam power or chemical fertilisers. We can only add to it, and that rather sparingly. We cannot increase the number of our crops. Harvest only comes once a year. Thus the examples of the printing press and of the loom fail to impress the farmer with what science is to do for *him*. Let it not, however, be thought that there is not scope for the application of science to agriculture. If we cannot multiply we can increase our produce and cheapen processes. The uses of fertilisers; the comparative values of foods; the improvement of instruments; the introduction of steam; the propagation of improved animals; the study of grasses and economic plants in general; the improvement of wool and of cereals; the introduction of new and cheap building materials, &c., are all worthy of attention, and all require the aid of science.

Prof. Beal points out the importance of meteorology to the farmer. He illustrates this by a quotation from Dr. R. C. Kedzie, who wrote in 1882, "If specific warnings had been given our farmers at that time (harvest), most of the wheat might have been safely housed, and the farmers of Michigan saved from a loss of $1,000,000." Another point made by the professor refers to our imperfect knowledge of those epidemics which from time to time visit our own flocks and herds, as well as those of America—

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"Among the drawbacks that may be specially named is the ignorance of legislators, of executives, and electors on this subject."

With this English readers will entirely concur. The next subject proposed as a definite object of study is that of economic entomology. Such enemies as the Colorado beetle, the wheat midge, the turnip fly, the wire worm, or the locust are among the most formidable which the farmer has to contend with. The depredations of the wheat midge alone may be appraised at over 3,000,000 bushels annually in Great Britain. Our Royal Agricultural Society has taken up this matter, and Miss Ormerod's book upon injurious insects is full of information and suggestions concerning it. This certainly is a branch of knowledge which requires labourers. From it we are led to reflect upon the important bearing of the study of *entozoa* upon agriculture, and especially upon the pathology of farm stock. The improvement of the American pastures appears to be desirable. According to Prof. Beal, a dozen sorts of grasses probably cover nineteen-twentieths of all the cultivated meadow-land from Maine to Texas. As the grass family is large, containing from 3100 to 4000 or more species, it is naturally thought that a few more might be found suitable for various parts of this immense area.

Not only is much to be done in the introduction of new grasses but in selecting and propagating varieties of the same grass. "Plants of red clover vary amazingly in many respects." "I believe our fields of red clover to-day contain nearly or quite as great a variety of plants as would a field of Indian corn, if we were to mix in a little seed of all the varieties cultivated in any one State." This is startling, but quite in accord with the wonderful variations observable in plants of Italian and perennial rye grass and other grasses and clovers. Thus Prof. Beal indicates various paths for improvement, and urges the vast importance of agricultural experiment stations, where work bearing upon the various subjects enumerated may be carried on by competent persons. There is nothing very new in all this. The importance of agricultural research has been often declared in our own country from the days of Sir Humphry Davy until now; but too often the voice has been as of one crying in the wilderness. Some good has been done, and we may expect a more rapid development of these ideas ere long. Scientific agriculture was never more popular than at present, and the number of agricultural students attending systematic courses of instruction is greater now than at any previous time. Agriculture has become a recognised subject of the Science and Art Department, and we note a disposition on the part of scientific men to attach greater importance to the study of domesticated animals and cultivated plants than formerly. We owe much of this to Darwin. He, more than any other man, raised the scientific interest of these humbler subjects of zoological and botanical science, which had previously been passed by scientific men with scarce concealed contempt. Anthropology has also done much to throw a halo of interest around those animals and plants which have been associated for long ages with man. Hence there is a greater bond of union between the present generation of scientific men and the agriculturist than existed a generation since, and it is probable that this sympathy will increase and fructify for the benefit of all.

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THE GREAT NEBULA IN ORION

IT is a fortunate circumstance for students of nebular astronomy that within a short time that branch of science has been enriched by a monograph and a photograph, each perfect in its way, of one of the grandest objects in the heavens. The monograph is from the pen of Prof. Holden,[1] whose name is a guarantee of thoroughness; the photograph we owe to Mr. Common, who at one bound has distanced all predecessors, and has shown us that in the future we may hope for permanent records of the nebulæ as perfect as those of the surfaces of the sun and moon produced by Janssen and Rutherfurd.

In the present article we propose to refer to both these productions with a view of showing how terribly physical astronomers are losing time in not throwing all their energies into the production of photographic records whenever possible. In Prof. Holden's paper we are enabled to see how, two hundred years ago, time was lost and false issues raised because the astronomers of those days had never learned to draw; indeed it is terrible to look at the collection of rude, crude, and almost impossible sketches by Huyghens, Mairan, Picard, Long, Le Gentil, and others which he has brought together. Mr. Common on his part has shown us that it is possible to photograph, with about half an hour's exposure, all the details shown in the most careful drawings made by men with artistic training as the result of months—and we may almost say years—of labour; such drawings as we owe to Bond, Herschel, and Lord Rosse. Mr. Common's photograph, it should also be said, includes the whole nebula, while the monograph is confined to the central portions.

The most convincing argument, however, in favour of the more serious employment of photography in our observatories, that we can use is to show the relation of the photograph to the memoir. The latter commences as follows:—"The main object of this memoir is to leave such measures and descriptions of the brightest parts of the nebula of Orion as shall enable another person observing in after years with the same telescope, under like conditions, to say with certainty whether or no changes have occurred in those parts of this nebula."

To carry out this object everything touching the nebula written between 1618, when Cysat of Lucerne discovered it, and Holden's own observations of 1881 has been brought together and coordinated, and the labour and time this has required may be gathered from the fact that the list of the more important papers relating to the nebula consulted in writing the memoir cover four pages quarto and includes about two hundred entries.

Now it is not too much to say that in the case of an astronomer taking up the question a century hence, as Prof. Holden has now done, he would prefer the single photograph taken by Mr. Common in thirty-seven minutes to all the literature so admirably brought together by Prof. Holden; and if the world must in the meantime lose either the memoir and the records of the human effort of 2½ centuries on which it is based, or the photograph, then it is to be hoped that the photograph will be spared. We say this the more readily because we are certain that Prof. Holden will agree with us.

But it is time that we should refer to the memoir separately. It is preceded by Bond's magnificent drawing, 1859-63, and an index chart giving the minute system of nomenclature necessarily adopted to distinguish the various bright masses, dark channels, spirals, &c., of the portion under notice. The nomenclature is that of Sir John Herschel, Lord Rosse, and Liaponoff in the case of the nebula proper, while the stars are laid down from Bond's catalogue. The index map is indeed the only part of the memoir with which we have any fault to find, for it attempts too much, and for that reason will be of restricted use to those whose optical power is not of the greatest.

The drawings and memoirs are considered in chronological order; the woodcuts bring up the drawings to the same scale, or nearly so. We have the woodcut first, and then extracts of the *ipsissima verba* of the observations. Everything touching the central portion is given

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[1] "Washington Astronomical and Meteorological Observations," vol. xxv., 1878. Published 1882.

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